

THURSDAY, JULY 31, 1919.

APPLIED CHEMISTRY.

- (1) *Boiler Chemistry and Feed-Water Supplies.* By J. H. Paul. Pp. ix+242. (London: Longmans, Green, and Co., 1919.) Price 14s. net.
- (2) *Reports of the Progress of Applied Chemistry.* Issued by the Society of Chemical Industry. Vol. iii. Pp. 495. (London: Society of Chemical Industry, 1918.) Price 10s. 6d.
- (3) *Trinitrotoluenes and Mono- and Dinitrotoluenes: their Manufacture and Properties.* By G. Carlton Smith. Pp. vii+133. (London: Constable and Co., Ltd., 1918.) Price 8s. 6d. net.

(1) MR. J. H. PAUL is a well-known authority on the chemical principles involved in the management and control of steam-boilers, especially in regard to the nature and selection of their feed-waters and of their treatment in the prevention of boiler-scale and corrosion.

In the book before us, which has been written mainly for the use of engineers and practical men possessing, presumably, a limited knowledge of chemistry and of chemical terminology, the author has sought to explain, in non-technical language, the character of the reactions which occur in natural waters containing a variety of soluble saline substances, when heated for the purpose of steam-raising at the relatively high temperatures and pressures of modern boiler practice. The nature of the changes which may occur under these conditions is probably more complex than is usually assumed, and certain of them are possibly complicated by the circumstance that they are of the character of reversible reactions, and subject to the laws of mass action and to the variable influence of temperature and concentration.

In some seventeen chapters the author describes the various forms of natural water, with special reference to their suitability for steam-raising; the nature of their saline constituents; the composition of the various scales and boiler deposits; modes of softening water; the character and influence of the permanently soluble salts; the action of carbonic acid; its behaviour towards iron; the general question of boiler corrosion, its causes and prevention; good and bad boiler practice, etc. The book is largely based upon personal experience, and contains the results of numerous original analyses of water-supplies of all kinds and from all parts of the world, and of various deposits, internal and external. It can be recommended as a trustworthy guide to those concerned in boiler work. It will be gathered that it deals more with practice than with theory, and it must be stated that the rational explanation of certain of the phenomena given by the author is open to question; indeed, it is admitted that the section of the work dealing with the action of carbonic acid on iron is largely speculative, and may have to be modified when more is known on the sub-

ject. In spite of his avoidance, as a rule, of technical language, the author is constrained at times to express reactions by means of chemical equations, of some of which the validity cannot be considered as established, and it somewhat savours of dogmatism to neglect the evidence of other observers. "It has been felt that the principle of giving authorities is a subterfuge for passing on to others a responsibility an author has not the courage to assume on his own account." This is surely a very unscientific attitude of mind. There should be here no question of subterfuge or of courage or the lack of it. He who wishes to gain, as fully as possible, a knowledge of the facts desires to have an independent corroboration of them, and for Mr. Paul to arrogate to himself an *ex cathedra* position as the sole authority detracts from, rather than enhances, the weight of his testimony. As a searcher for the truth it is incumbent on him to cite whatever evidence bears upon it.

(2) Vol. iii. of the annual reports issued by the Society of Chemical Industry deals with the progress of applied chemistry made during 1918. As in the case of the two previous reports, it is mainly based upon material published by the society in its fortnightly journal issued during that year. Its plan is practically identical with that of its predecessors, and many of its contributors are the same as in previous cases. Two important sections are added, viz. agricultural chemistry and foods. On the other hand, three are omitted, viz. ceramics, building materials, and fermentation industries, as the compilers of these sections failed to send in their copy in time to be included in the present volume. Considering the range of material to be dealt with, and the number of contributors engaged, *lâches* of this kind are probably unavoidable, but they detract, of course, from the value of the report as a comprehensive and complete summary of the particular year's work, and necessitate, as in the present case of the added sections on foods and agricultural chemistry, the compression of the work of several years in a single report. There is, to this extent, a certain lack of uniformity in treatment and an absence of continuity which are to be regretted, but for which the editor and the publication committee are scarcely to be held responsible.

In the present volume the various departments of applied chemistry treated of are grouped under twenty-two sections. It is obviously impossible, in the limited space at our disposal, to deal with them all in detail, and we propose to select those for the purpose of comment which are of general interest or of particular importance at the present time of "reconstruction."

The value of these annual reports is greatly increased when particular sections are handled in successive years by the same author, provided that he is competent and has the necessary critical skill; and the excellence of his summary is augmented if he prefaces it by a general statement of the more striking marks of progress which

have characterised the year's work. Such a statement is probably best put together after the detailed account of the year's literature has been compiled, and when, as it were, the material has been brought to focus. The greater number of the contributors, especially those who have been engaged on previous reports, actually make these general surveys, but the practice is not uniform, and the surveys are neither of the same interest nor show the same grasp and critical skill. This perhaps is to be expected. Progress in some departments of applied chemistry is very slow, especially in minor industries, and such developments as do occur are often not particularly striking.

Of the new contributors, Dr. Dunn, of Newcastle-upon-Tyne, contributes an admirable *résumé* on "Fuel," in which he deals with a wider range of literature than is noted in the society's journal; Mr. Alwyne Meade, of the Commercial Gas Co., Wapping, treats of "Gas-destructive Distillation-Tar Products" in a well-arranged and succinct digest of some twenty pages; while Mr. Arnold Philip, the Admiralty chemist at Portsmouth, occupies about the same space with an excellent *résumé* of the present position of the mineral oil industry, with special reference to its applications as fuel. Although the matter is not, strictly speaking, relevant to the title of this particular section, Mr. Philip is naturally led to discuss the question of the possible substitution of alcohol, wholly or in part, for petrol as a motor-fuel—a question which is again being actively ventilated owing in great measure to the present high price of petrol. The author is evidently not very sanguine that alcohol is likely to play any considerable part as a motor-spirit unless some form of co-operation on the part of motor users, or some form of control by the State, as in Germany, checks the destructive competition between the producers of alcohol and of petrol which will inevitably set in. As matters stand at present the great petroleum corporations can at any time afford to undersell alcohol, and can undoubtedly ruin any undertaking engaged in the manufacture of industrial alcohol for motor-fuel. The question has engaged the attention of a Departmental Committee, and a report upon it has recently been issued. The whole matter is beset with administrative difficulties, and will presumably need legislative action, if any practical effect is to follow from the Committee's report.

Other new contributors are Capt. Nash, of the Chemical Warfare Department, on "Paints, Pigments, Varnishes, and Resins"; Dr. Twiss, of the Dunlop Rubber Co., on "Indiarubber"; Mr. F. C. Thompson, of the Leather Industries Department of the University of Leeds, on "Leather and Glue"; Dr. E. J. Russell, of the Rothamsted Experimental Station, on "Agricultural Chemistry"; Mr. I. P. Ogilvie, the technical editor of the *International Sugar Journal*, on "Sugars, Starches, and Gums"; Dr. Bywaters, lecturer on general metabolism at the Bristol University, on "Foods"; Dr. Arden, the chief chemist of the Manchester Corporation's

Rivers Department, on "Water Purification and Sanitation"; and Prof. Barger on "Fine Chemicals, Medicinal Substances, and Essential Oils." It will be seen that in all cases the editor has been fortunate in securing the co-operation of recognised authorities in the particular sections entrusted to them.

The remaining sections have been undertaken by previous contributors. Prof. Morgan continues his admirable series of reports on "Colouring Matters and Dyes"; Mr. Briggs deals with "Fibres, Textiles, Cellulose, and Paper"; Mr. Higgins with "Bleaching, Dyeing, Printing, and Finishing"; Dr. Auden with "Acids, Alkalis, Salts, etc."; Mr. Rees with "Glass and Refractories"; Mr. Bannister with "The Metallurgy of Iron and Steel"; Mr. Patchin with the "Non-ferrous Metals"; Mr. Hale with "Electrochemistry"; and Messrs. Revis and Bolton with "Fats, Oils, and Waxes."

There is much in this excellent series of digests of general interest, and had space permitted we should have been tempted to direct attention to many points of novelty and importance. Certain of the sections overlap to a slight extent, and, as might be anticipated when we are dealing with matters at the very frontiers of progress, authorities occasionally differ, as, for example, concerning the importance or otherwise of the presence of vitamins in certain articles of food, as in margarine. But these reports are, or should be, generally accessible to all who are concerned with the multifarious applications of chemical knowledge, and the price at which they are issued brings them within the reach of all who are interested in the progress of applied chemistry.

(3) Mr. Carlton Smith's little monograph on the nitrotoluenes is, like its subject, a product of the war. Its author is on the staff of the School of Applied Science of the Pittsburgh Carnegie Institute of Technology. The book is mainly concerned with the history, modes of manufacture, and properties of the trinitrotoluenes, and particularly of T.N.T., which, under the various names of troyl, tolite, trilit, trincl, tritolo, etc., is now largely used as an explosive in war by practically all nations in substitution for picric acid. During the late war the demand for it was enormous, and large quantities of it were made by American manufacturers on account of the high price it commanded. Mr. Smith's book is mainly concerned with the methods of production as carried on in the United States. It is presumably written for the information of the manufacturer; as a scientific treatise it has few merits; the explanation of the theory of nitration is confused and misleading, and the historical account is incomplete. Literary composition is evidently not the author's strong point, and his orthography and punctuation are occasionally erratic. For Walters (p. 6) read Walter; for Hoffman (p. 7) read Hofmann; for Rosenstill (p. 12) read Rosenstiehl; for Lamprecht (p. 16) read Limpricht; for Nolting and Witte (p. 16) read Noeltling and Witt; for Astro-

misslewsky read Ostromisslensky. "Roberite" (p. 108) is usually written "roburite"—at least on this side of the Atlantic; and "Anallen" in the list of references should be "Annalen." These are blemishes which should not occur in a book written by an instructor in general chemistry in so important a school as the Carnegie Institute of Technology.

THE PRINCIPLES OF RADIO-COMMUNICATION.

The Principles of Electric-wave Telegraphy and Telephony. By Prof. J. A. Fleming. Fourth edition, revised. Pp. xvi+707. (London: Longmans, Green, and Co., 1919.) Price 42s. net.

IT is no easy task to keep a large treatise on electric wave telegraphy and telephony abreast of the advances that have been made during the last few years. In this fourth edition the author has been very successful. He does not load up the book with descriptions of all kinds of technical apparatus, or attempt to describe all the methods used in practice. There is now quite a small library of highly technical works which give the required detailed information to the engineer, and to these Prof. Fleming refers the reader. What he does give is a comprehensive view of the subject, particularly on its scientific side. He also dwells fully on quantitative measurements and their theory, which he himself has done so much to develop.

In part i. a discussion is given of electrical oscillations. The mathematical proofs given are rigorous and straightforward, and will be appreciated even by those who are beginning to forget their knowledge of the calculus. The mathematical formulæ for the high-frequency resistance and inductance of circuits are given, and the author's successful experimental methods of testing these formulæ described. When the wires are curved, the mathematical difficulties in the way of computation are so great that engineers will welcome the experimental verification of the formulæ.

The tables given of spark-voltages between spherical electrodes are somewhat antiquated. The reviewer had occasion recently to analyse the experimental results on spark voltages published in the standardisation rules of the American Institute of Electrical Engineers (1918). The Institute used spheres varying in diameter from 3.125 cm. up to 50 cm., and the spark voltages go up as high as 400 kv. The results plainly show that when the voltages of the electrodes are equal and opposite at the instant of discharge, the maximum electric stress, R , at this instant, the temperature being 25°C . and the pressure 76 cm., is given by

$$R = 27.4 + 14.1/\sqrt{a}$$

kilovolts per centimetre, where a is the radius of either spherical electrode in centimetres. It was of interest, therefore, to see whether the

results (p. 188) obtained by Heydweiller in 1893 on spheres of 0.5, 1, 2, and 5 cm. were in agreement with this formula. We find that when we correct for temperature and pressure they are in most excellent agreement. It follows, therefore, that if V be the spark voltage when the distance between the electrodes is x , we have

$$V = (R/f)x,$$

where f is a mathematical factor depending on x and a , a table of the values of which is given on p. 145 of this book. This is at least true for spheres varying in diameter from 0.5 up to 50 cm., values of x less than about a millimetre being excluded. Various theories have been given to explain why R should be the sum of two terms as shown above, but in the reviewer's opinion those theories which neglect the effects of the convection currents of air flowing round the electrode prior to the discharge are wrong.

In part ii. electric waves are discussed, and a very complete account is given of methods of measuring and detecting them. The remainder of the book is devoted to radio-communication. It begins with a short history of the subject. Then various long-distance telegraphic stations are described, the salient points of the systems of working being pointed out. The theory of transmission is given. Full descriptions are given of several of the latest developments of the art, such, for instance, as the Marconi military set for wireless apparatus, and the Marconi sets used in aircraft.

The final chapter treats of radio-telephony, and is perhaps the most interesting in the book. It is extraordinary what rapid progress is being made in this branch of the subject, and how different are the methods employed by the various experimenters. Marvellous results have been obtained by the Fleming oscillation valve. The almost incredible sensitivity attained in receiving apparatus by the use of thermionic amplifiers warrants the most sanguine hopes for the future of radio-telephony.

We ought to mention that, although additions have been made to the book to bring it up to date, yet by the deletion of antiquated matter and the use of smaller type the total bulk of the volume has been reduced. This is an advantage, as the earlier editions were beginning to get unwieldy. We can recommend this book to everyone interested in radio-telegraphy. To the scientific radio-telegraphist it is a necessity.

A. RUSSELL.

GEOGRAPHICAL ASPECTS OF WORLD POLITICS.

Democratic Ideals and Reality. A Study in the Politics of Reconstruction. By H. J. Mackinder. Pp. 272. (London: Constable and Co., Ltd., 1919.) Price 7s. 6d. net.

THERE is no lack of ideas in this book. From beginning to end it is full of striking conceptions which arrest attention even if some of